WP4: Data Analysis and AI Algorithms

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Steering Commitee Meeting Edinburgh, 17/11/23

WP4 - Staff

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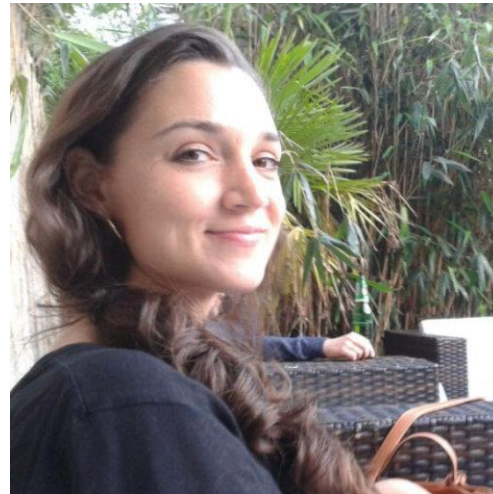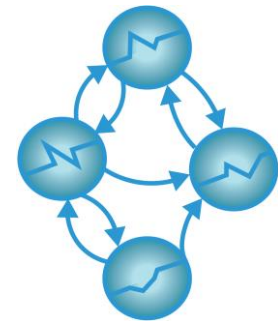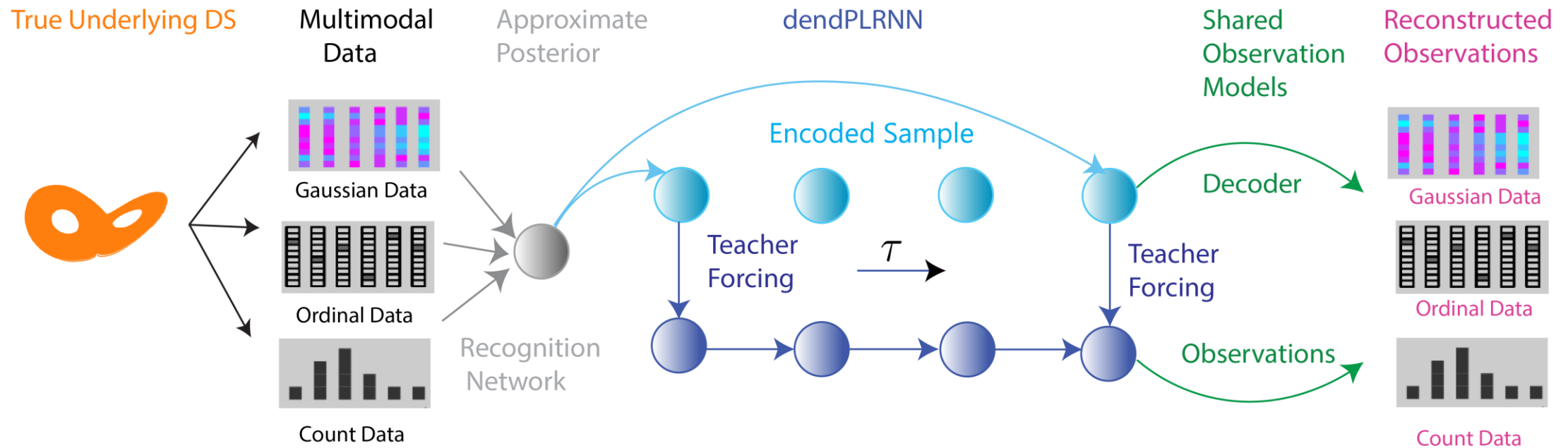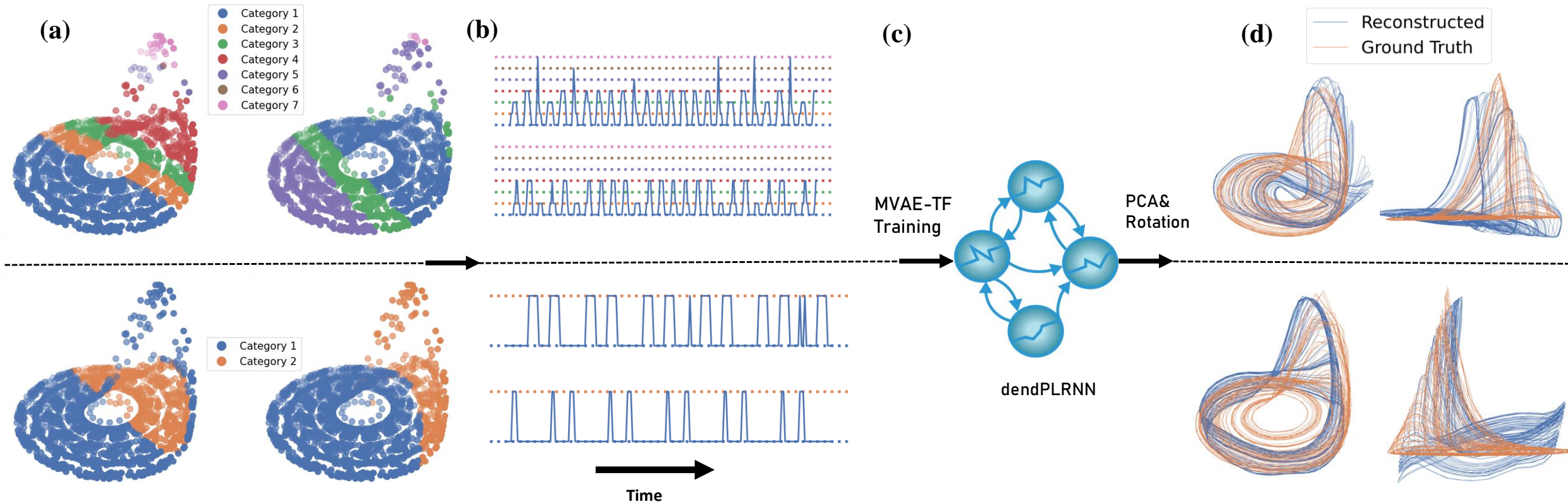
WP 4.2 – AI Algorithms

WP 4.2 – AI Algorithms

Multimodal Variational AutoEncoder+ Teacher Forcing (MVAE-TF),
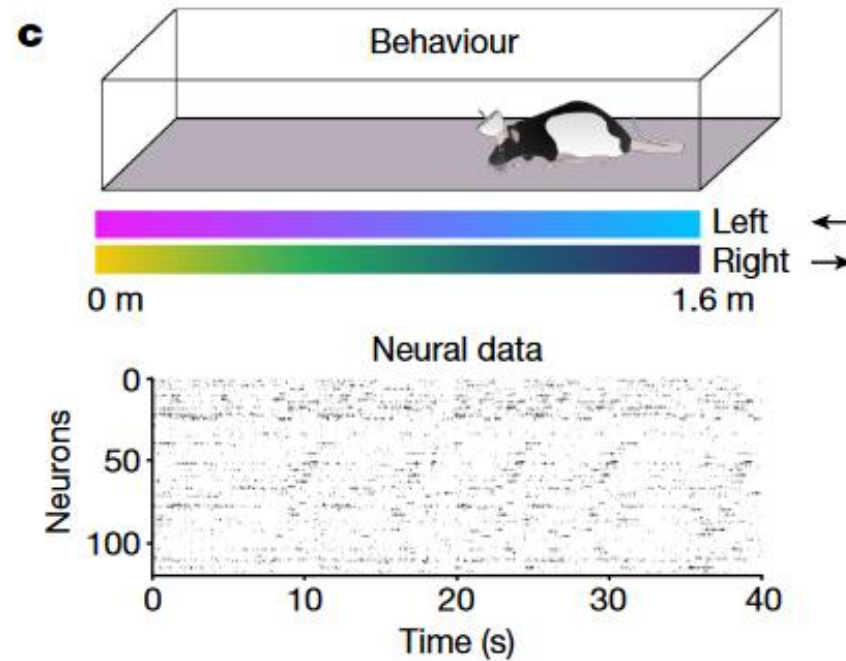AAAI23 Workshop

WP 4.2 – AI Algorithms

Reconstructed Dynamics from ordinal discretization

(a) **(b)** **(c)** **(d)**

MVAE-TF Training

dendPLRNN

PCA& Rotation

Time

WP 4.2 – AI Algorithms

Neural spike data, position data and cognitive labels

Goal: Learn a joint dynamics model of movement, neural spike trains in rat hippocampus and activity from prefrontal cortex, using MVAE-TF
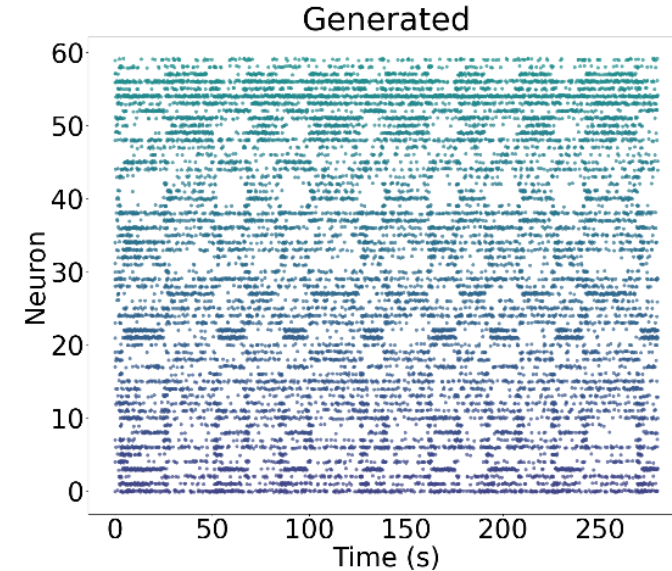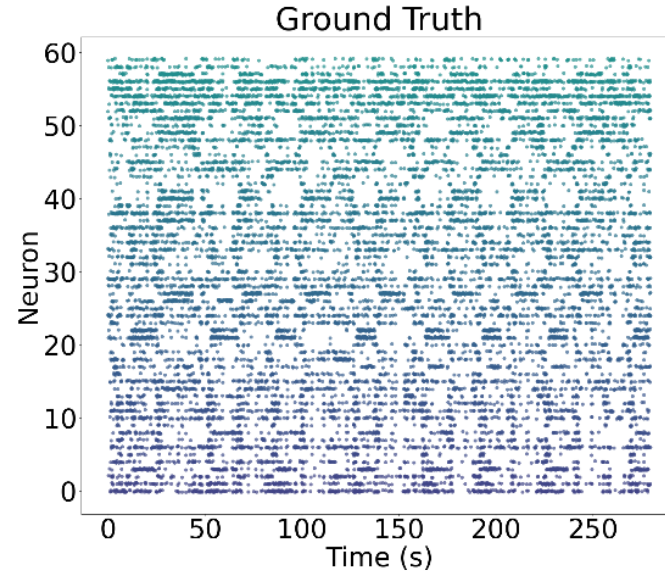
WP 4.2 – AI Algorithms

- Reconstructed spike activity closely resembles that of GT system
- Observation model can be tailored to match the assumptions of the observed data
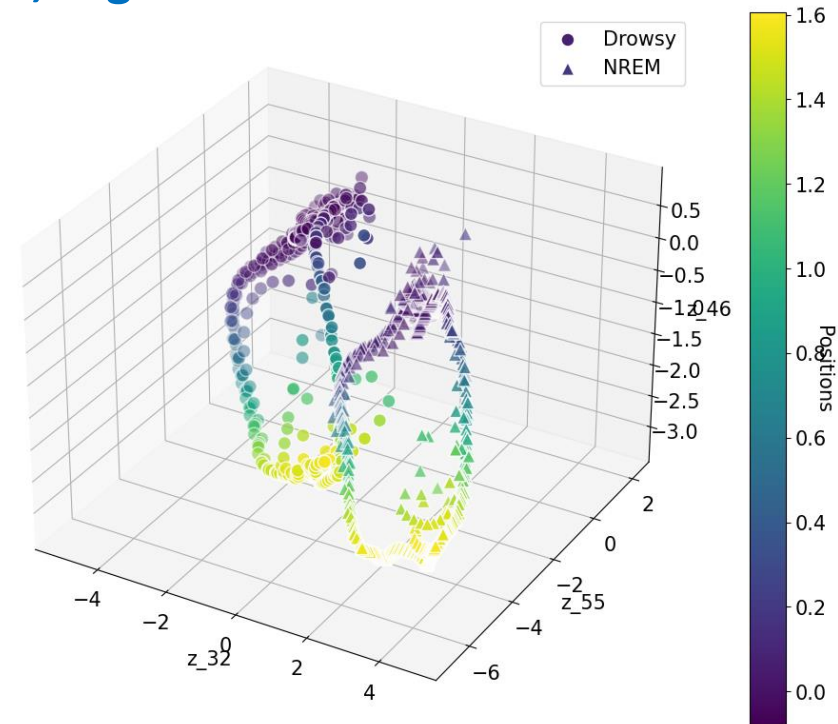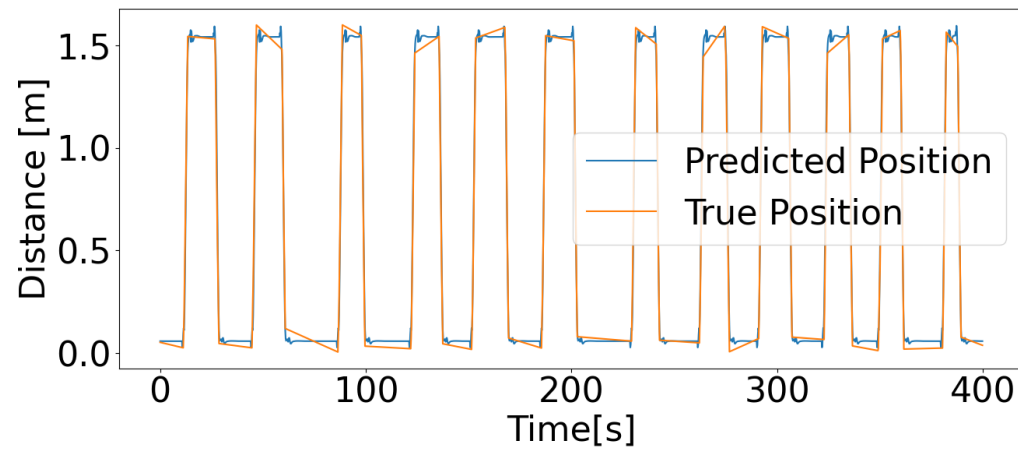
Negative Binomial Model

$$p_{\theta}\left(c_{lt} \mid z_t\right) = \frac{\Gamma(c_{lt} + \phi_l)}{\Gamma(\phi_l)c_{lt}!} \left(\frac{\phi_l}{\mu_{lt} + \phi_l}\right)^{\phi_l} \left(\frac{\mu_{lt}}{\mu_{lt} + \phi_l}\right)^{c_{lt}}$$
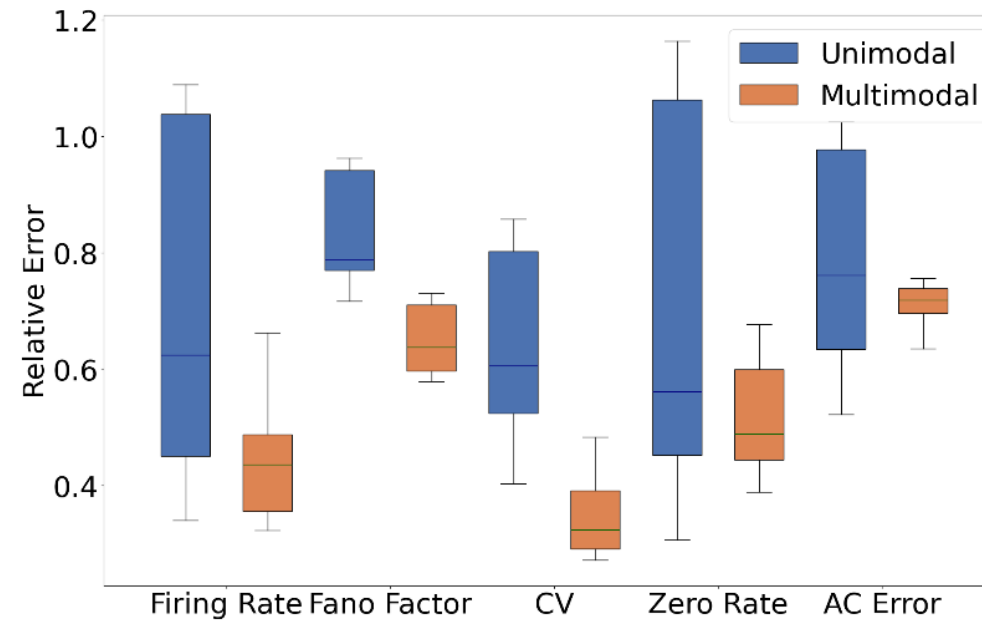
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Positional Coding

Latent model jointly encodes positional information, cognitive state and spike activity

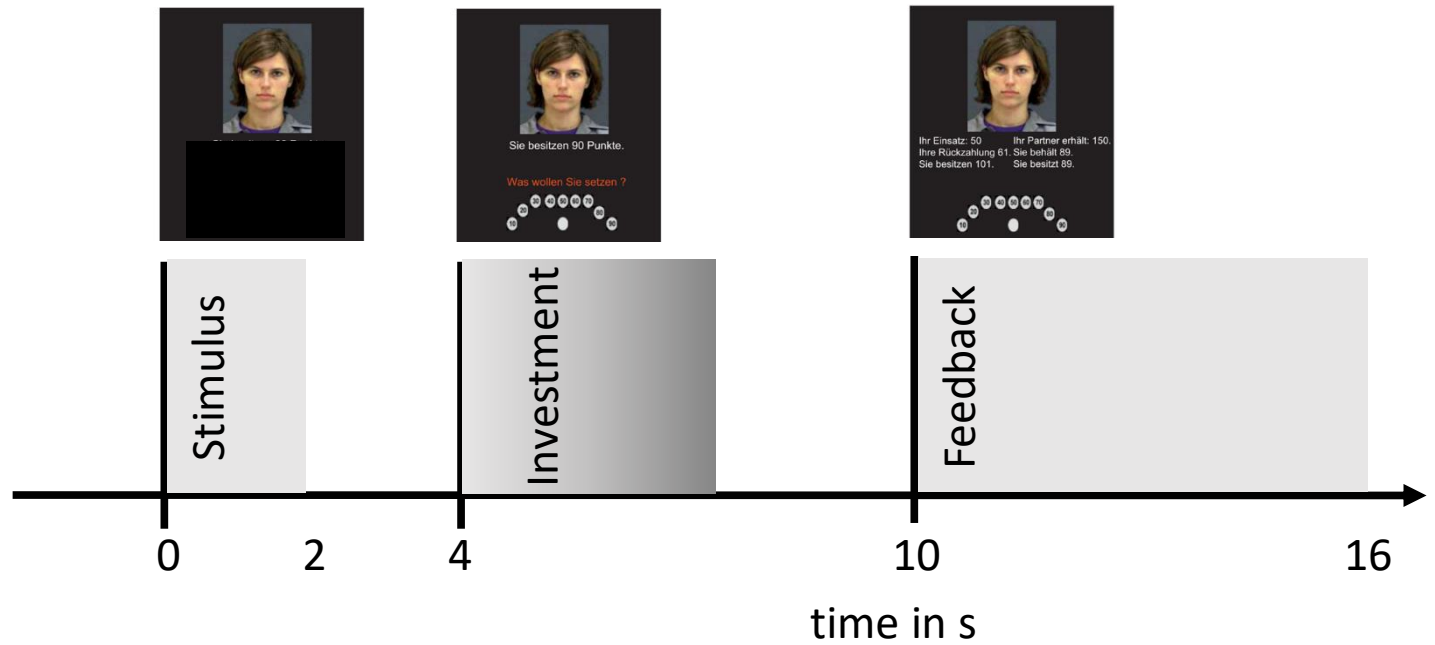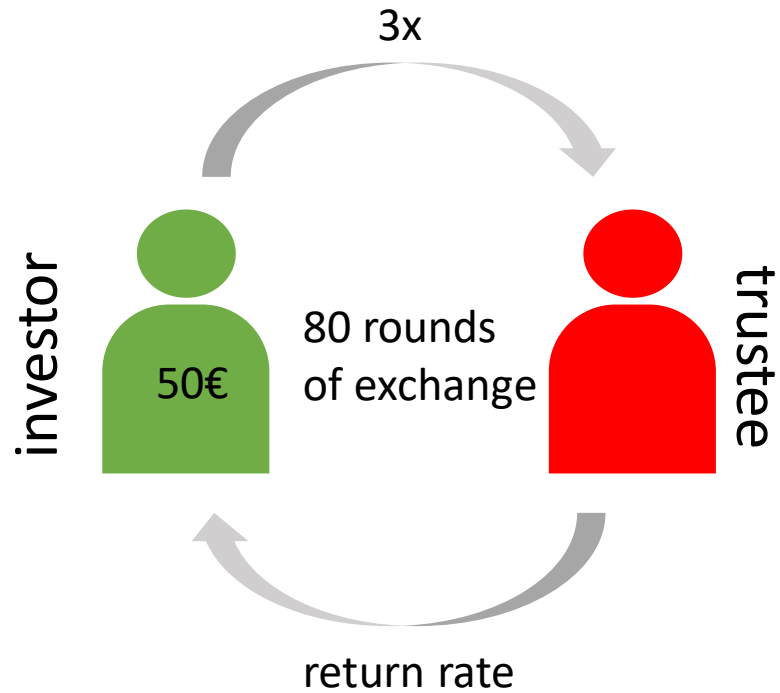# WP 4.2 – AI Algorithms

Reconstructions benefit from Multimodal Data Integration
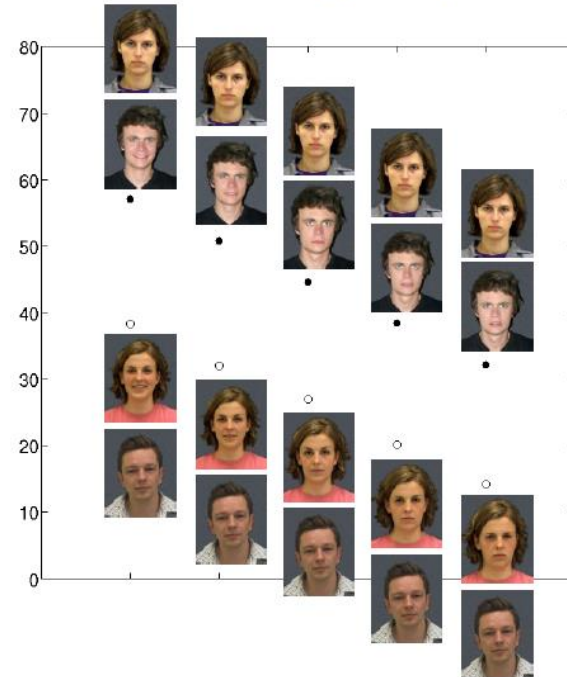
WP 4.2 – AI Algorithms

Modelling Social Interaction Data (TRR project)

WP 4.2 – AI Algorithms

Modelling Social Interaction Data
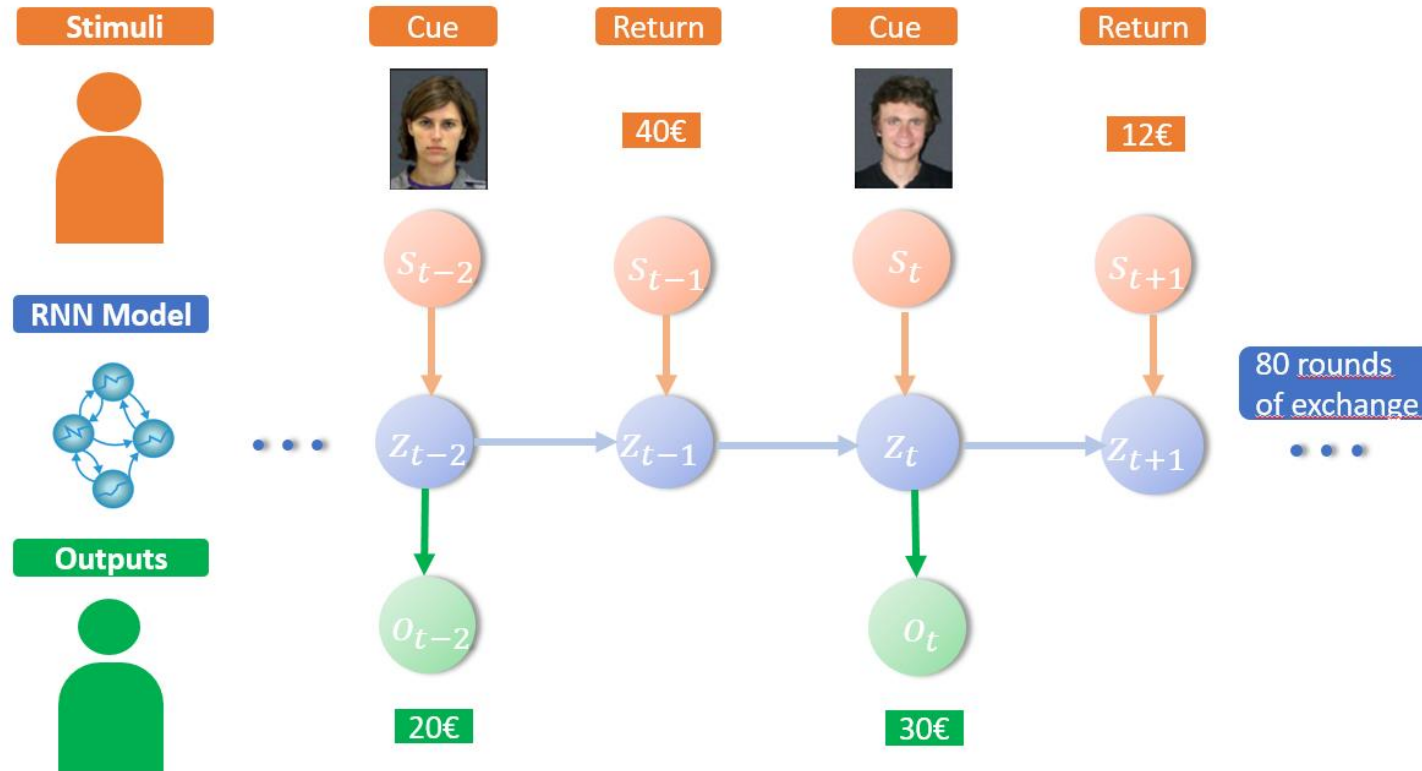
2 Faces (social)
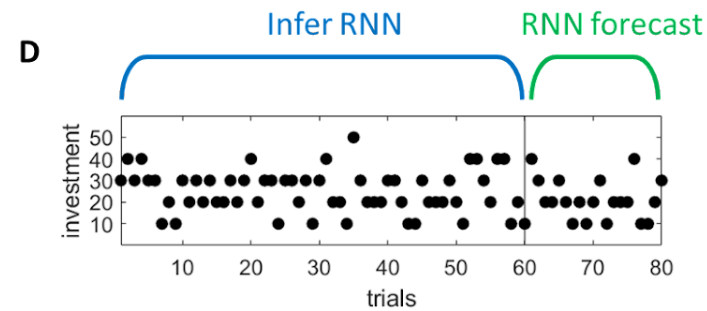
Fair

Unfair

Happy   Unhappy

WP 4.2 – AI Algorithms

WP 4.2 – AI Algorithms

Infer RNN | RNN forecast
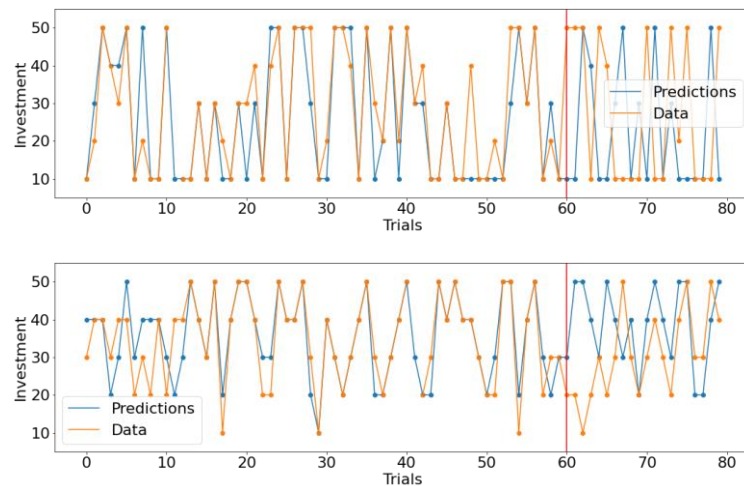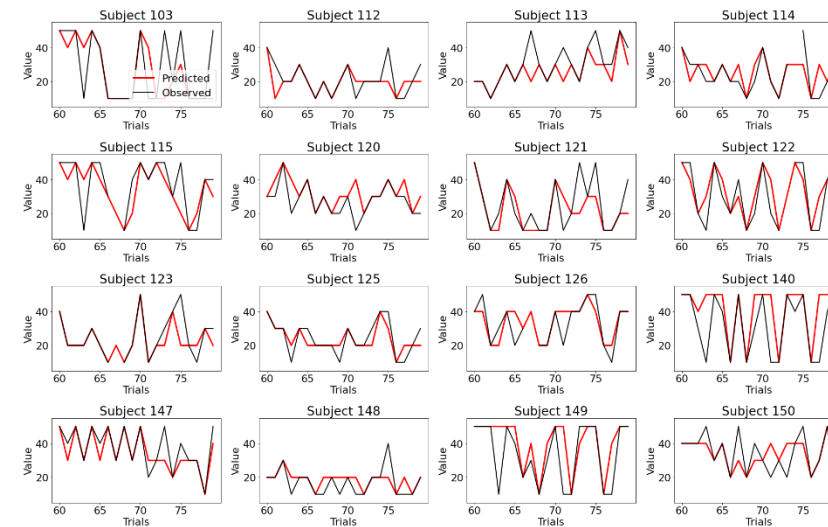
very small amount of data per subject, similar to EMA data

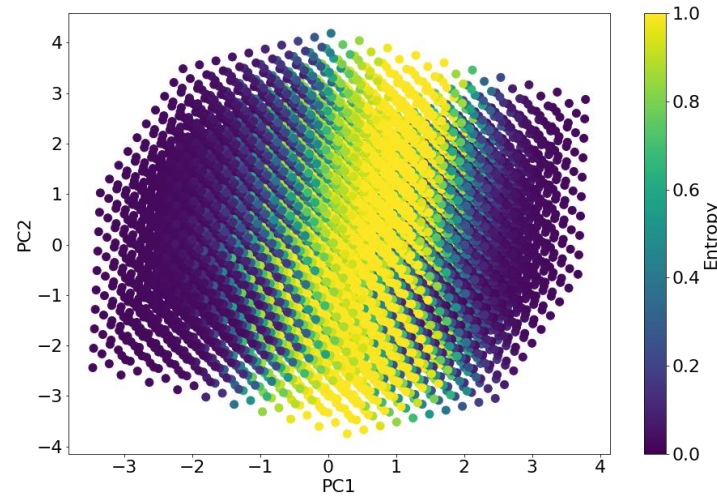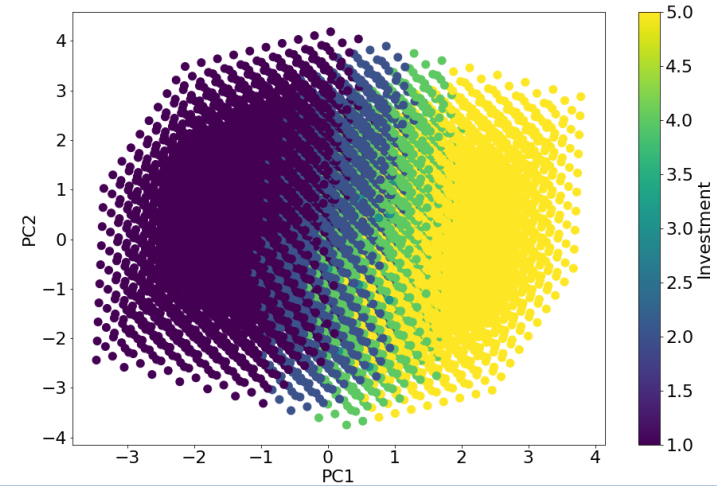**Train&Test Set Predictions**

Test Set Predictions

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"Uncooperative" ← → "Cooperative"
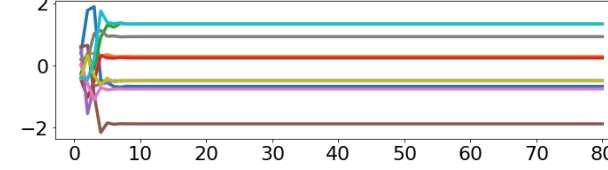
Uncertainty over which investment to make

Invested amount

WP 4.2 – AI Algorithms

Investment Dynamics

RNN Activity
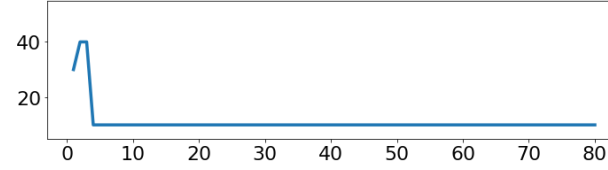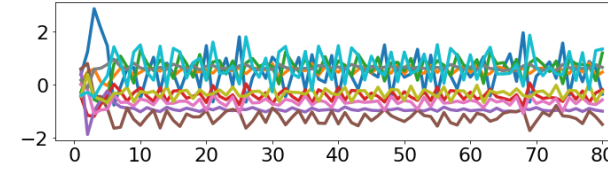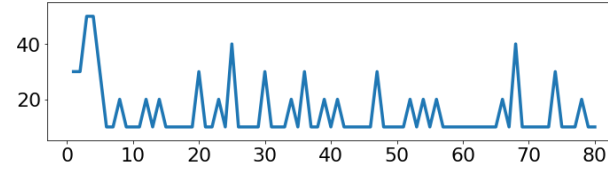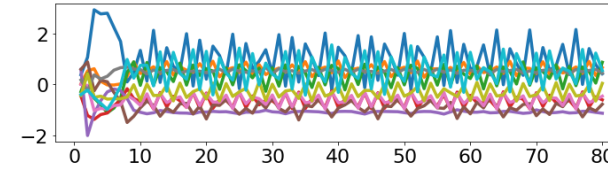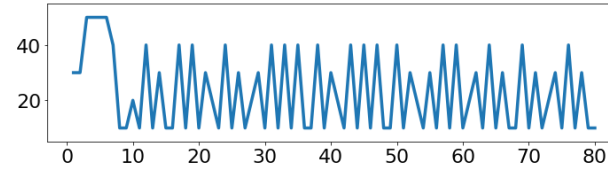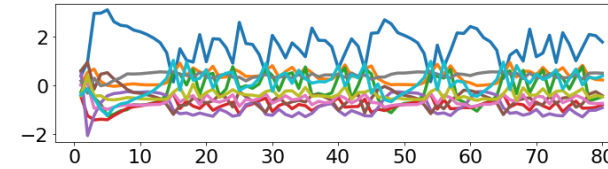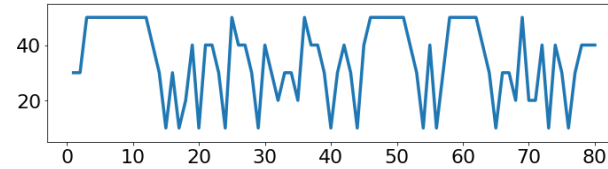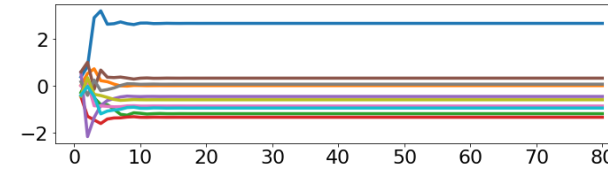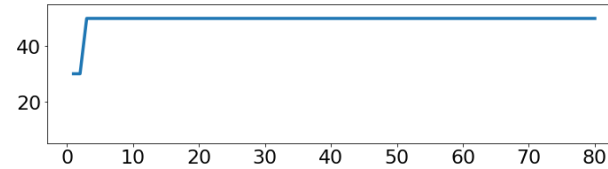
"Unfair" cue strength

WP 4.2 – AI Algorithms
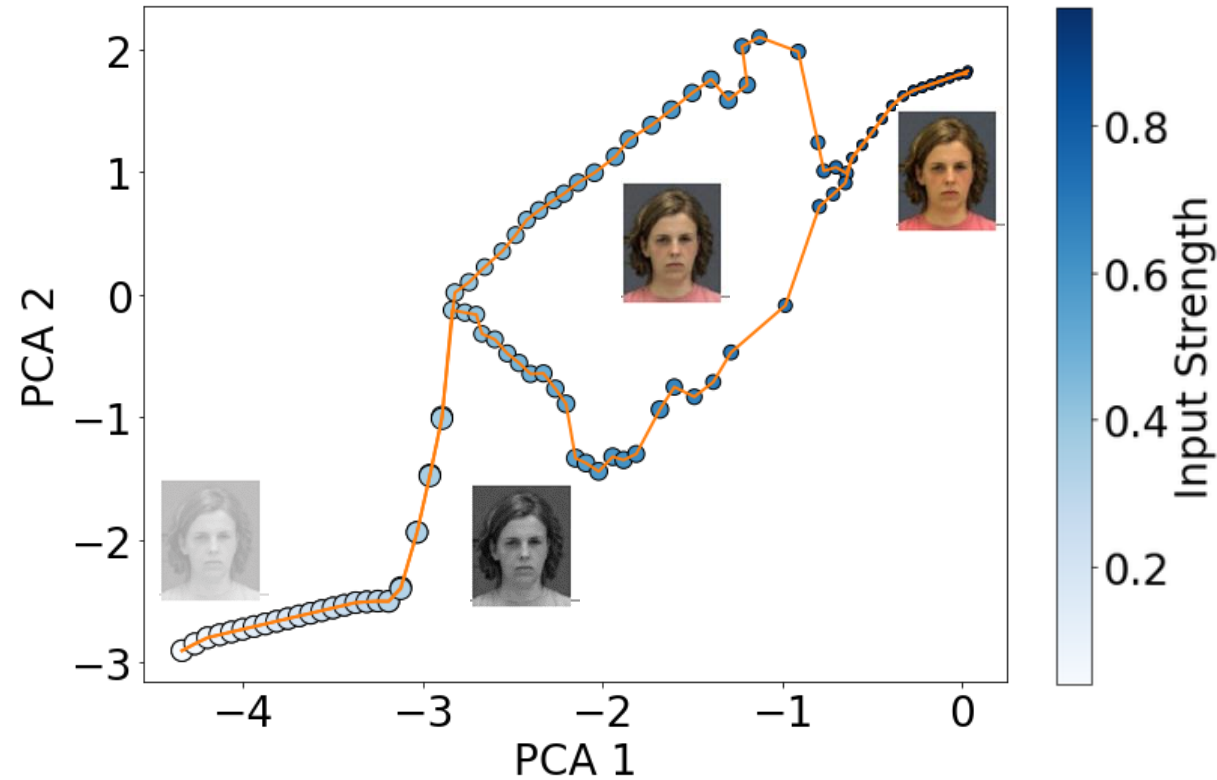
Subject 1

WP 4.2 – AI Algorithmsm

Model interaction with different agents (contrarian, supportive, trust-building)
→ Unsupervised discovery of different interaction styles
→Identification of interpretable behavioral traits and contingencies in personalized DTSM models
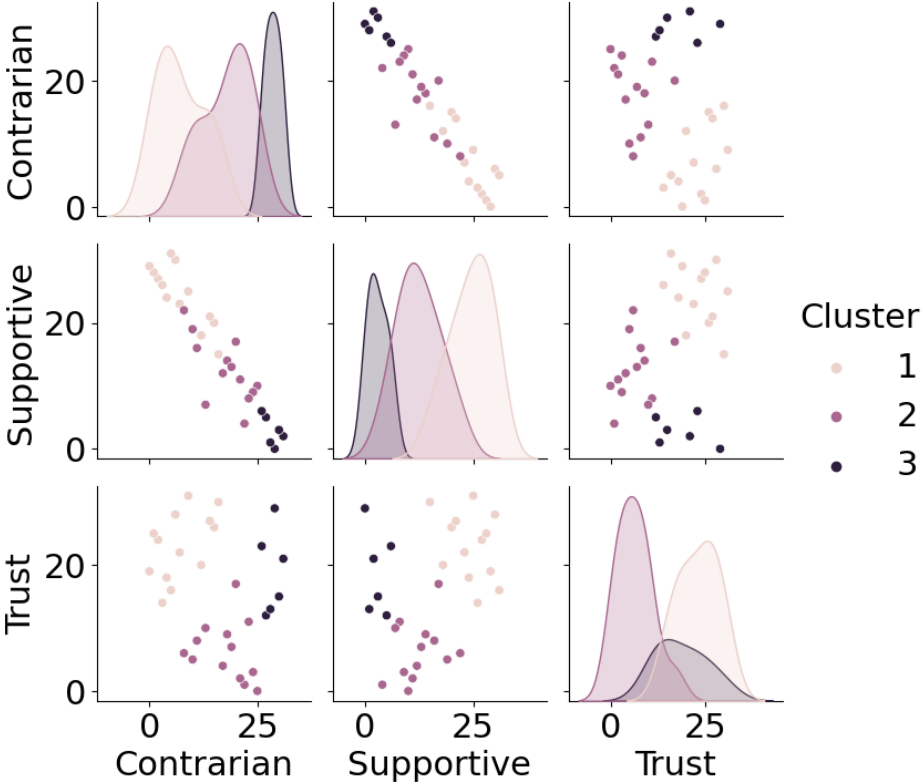
WP 4.3 Big data integration framework

Pre-training and hierarchisation framework
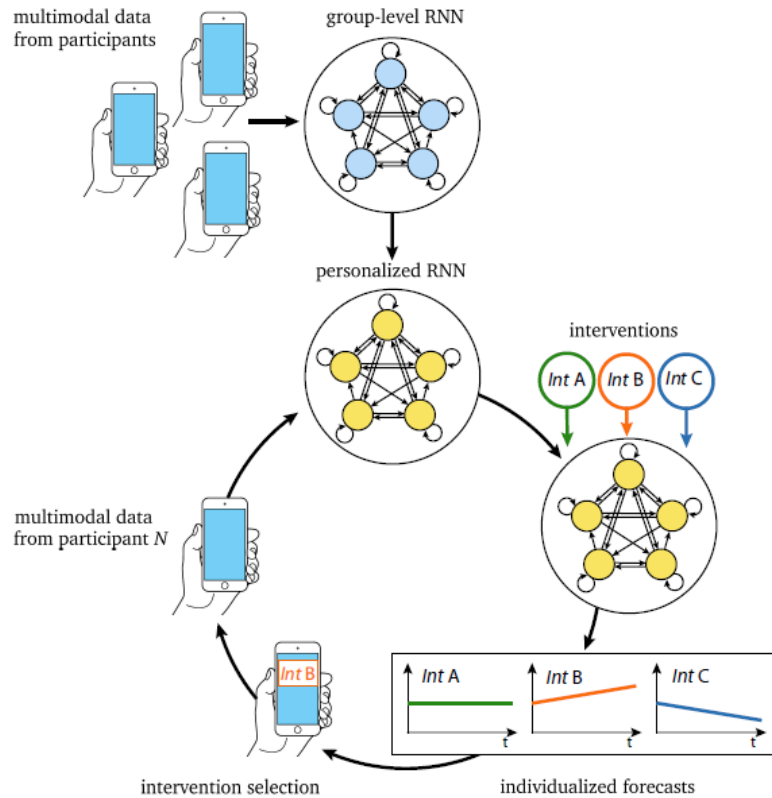
1. **Group level parameter**
2. **Subject level parameter**

$$\text{ELBO}_x(\boldsymbol{\theta}, \boldsymbol{\phi}) \approx \mathbb{H}(q_\phi(\mathbf{z}|\mathbf{x})) + \frac{1}{L} \sum_{l=1}^{L} \log p_\theta(\mathbf{x}, \mathbf{z}^{(l)})$$
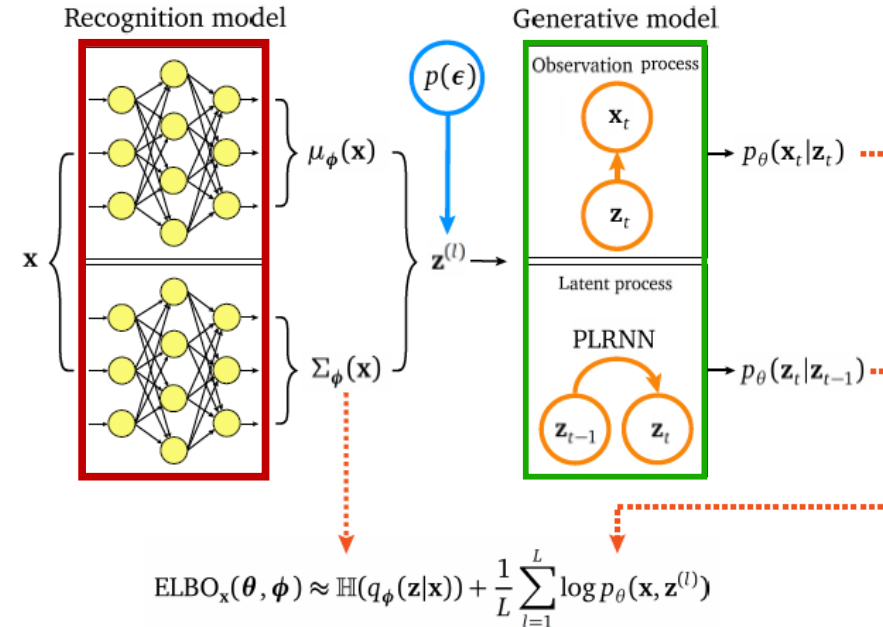
Unai Fischer Abaigar, MSc

WP 4.3 Big data integration framework

New hierarchisation Framework based on Singular Value Decomposition of RNN model parameters: only train SVs

Interpretable substructure

WP 4.3 Big data integration framework

small amount of data per „subject",
shared dynamics but subject specific parameter differences

Elias Weber, MSc

WP4 – Deliverables & Milestones

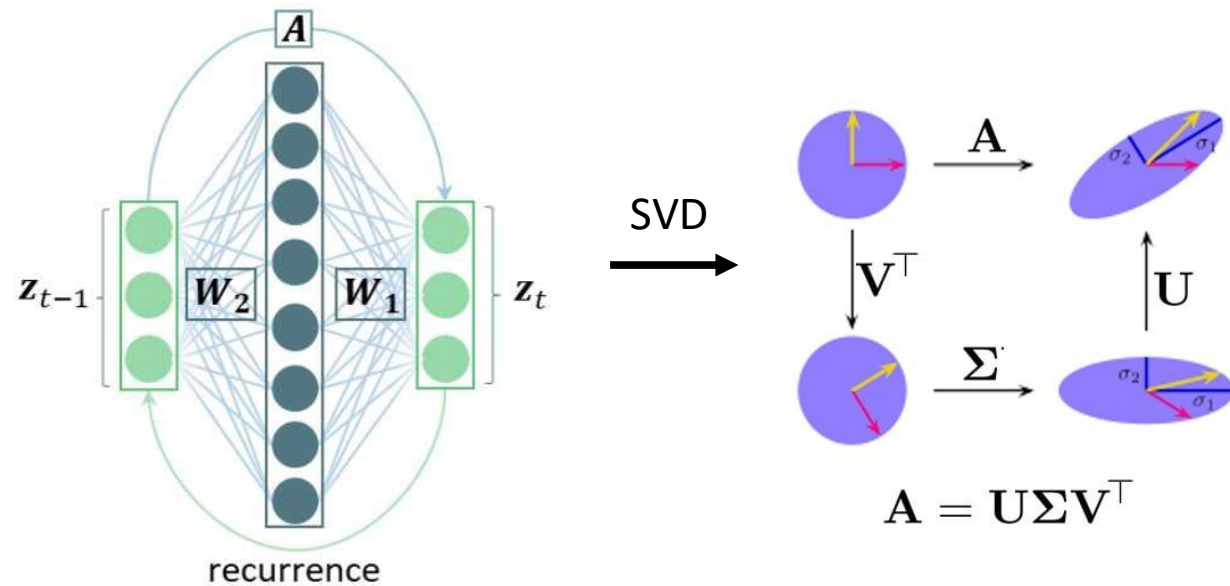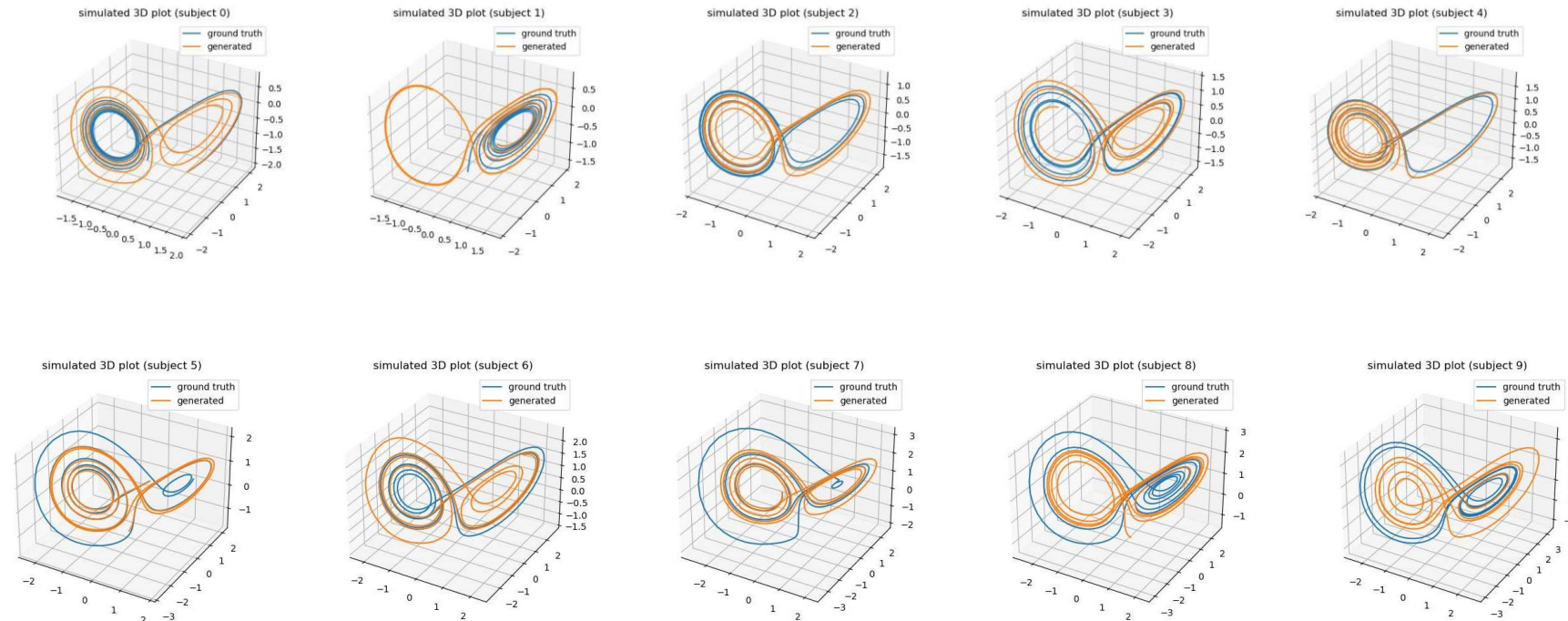| Milestone / deliverable	Title	Original deadline	Status
D4.1 ✓	Set of basic statistics for direct implementation and visualization	Month 9	✓
MS14	Identification of interpretable behavioral traits and contingencies in personalized DTSM models	Month 24	Ongoing
D4.2	Algorithms and software environment for DTSM-based multimodal big data integration	Month 36	Ongoing (✓)
MS18	Development of multi-site big data approach for ESM and DTSM models	Month 30	Ongoing
MS24	Cross-site validation of big data approach	Month 40	Not yet started
D4.3	Software for identification, visualization, and feedback of behavioral contingencies	Month 48	Not yet started

WP4 – Year 2023 Goals

- **First application of hierarchical framework to experimental data**
- **Extraction of interpretable features and relationships to psychological survey data**
- **Code documentation**

WP4 - Objectives

Collaboration / input other WPs

- Are read-out/preprocessing scripts for MoMent&movisense XS data from other projects useful (WP3 or downstream tasks)?
- What can we do on the data that is currently available?
- Since I don't have funding after March and switch to a new position we will have more limited capacity, but remain involved